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OPERATING INSTRUCTIONS

FOR THE

PHASE TEST SET TYPE 213-A

Boonton Radio Corporation

P. O. Box 390 Boonton, New Jersey, U.S.A.

OPERATING INSTRUCTIONS

TYPE 213-A PHASE TEST SET

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DESCRIPTION

The PHASE TEST SET was developed to provide a simple yet precise method of measuring and adjusting overall phase shift in the Type 211A Omni-Range Signal Generator. It is furnished complete with all interconnecting cables but requires the use of an auxiliary audio oscillator and oscilloscope.

THEORY OF OPERATION

A. "30~BRIDGE" Measurements (See Fig. 1)

For this method of operation the PHASE TEST SET is switched to produce two 30~signals of exactly equal amplitude but opposite phase (E1 and E2). These are combined to produce a balanced ("null") condition of zero output to the indicator circuits ($E_{out}=0$).

One arm of this balanced bridge is now opened, and the 211A circuits are inserted in series with this arm. The 211A is now adjusted to produce the same bridge condition as the short circuit it replaced. Amplitude balance is restored by adjusting the modulation level control of the 211A to produce unity voltage gain through the 211A; any remaining unbalance voltage at the bridge output (E_{out}) is due to phase shift, and is directly proportional to the amount of shift.

B. Conventional "Direct" Measurements (See Fig. 2)

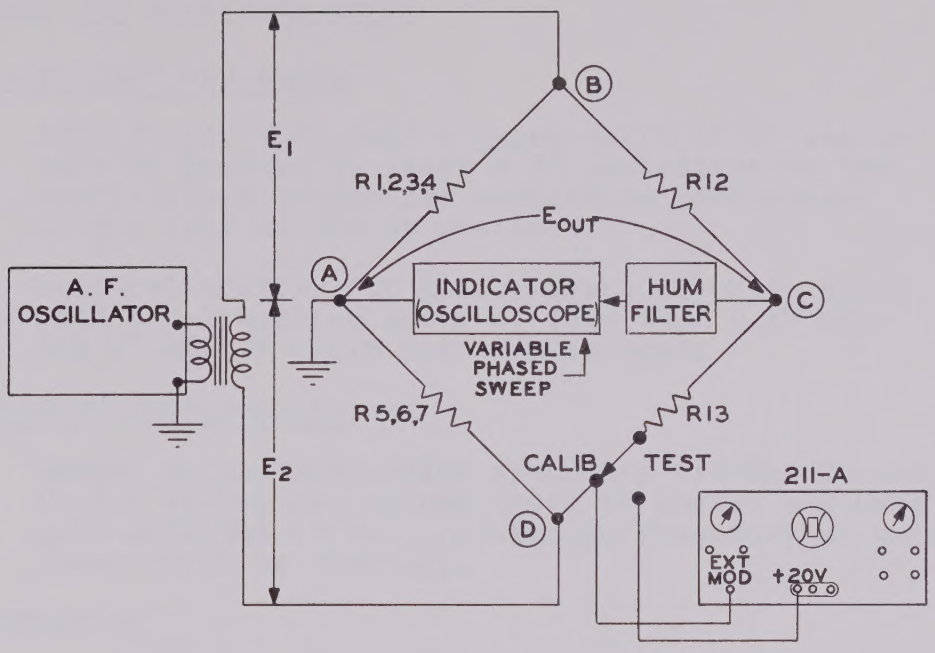
By switching the controls of the PHASE TEST SET, phase measurements at any frequency between 20 cycles and 11,000 cycles may be made by the conventional scope trace method.

C. Sweep Circuits

A variable phase sweep output is provided. Approximately 180° of continuous phasing adjustment is provided.

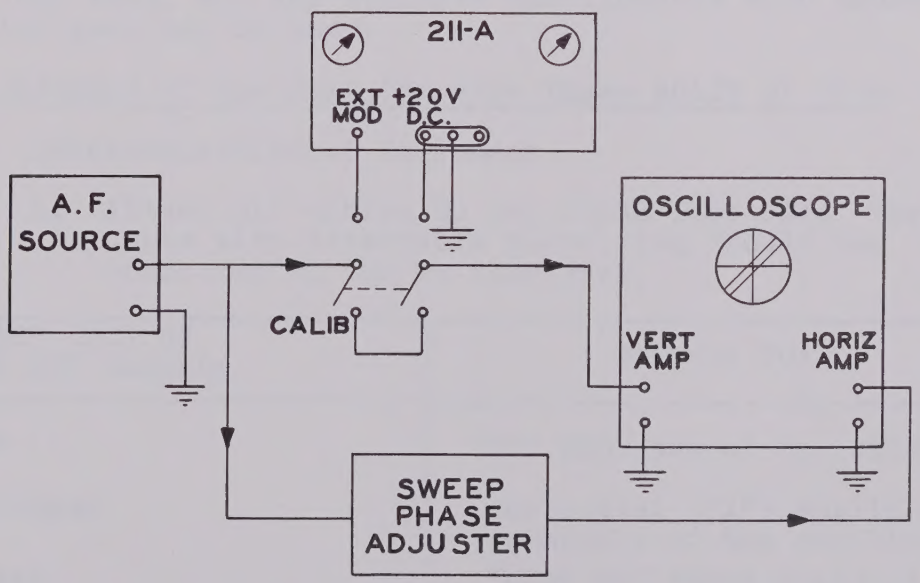
This range of sweep adjustment allows the oscilloscope presentation of the 30~BRIDGE unbalance voltage to be adjusted so that an amplitude-produced unbalance voltage will cause a tilt of the line trace and a phase-produced unbalance voltage will cause an opening of the line to form an ellipse.

The wide range of available sweep phasing adjustment also allows correction to be made for phase shifts within the oscilloscope amplifiers when checking shift by the conventional 45° trace method.



SIMPLIFIED DIAGRAM SHOWING THE "30~ BRIDGE" OPERATION OF PHASE TEST SET

Figure 1



BLOCK DIAGRAM SHOWING OPERATION OF THE PHASE TEST SET FOR "CONVENTIONAL" PHASE MEASUREMENTS

Figure 2

SPECIFICATIONS AND CHARACTERISTICS

A. "30~BRIDGE" Operation.

1. Sensitivity such that a phase shift of 1° can be made to produce at least a 2" deflection on the oscilloscope screen for modulation percentages of the 211A of 30% or greater.

2. Self calibrating for measurements of phase shift with a calibration error of less than 0.1° when the 1° BRIDGE CALIB position is used.

B. "DIRECT" Measurements

1. Useful at any modulation frequency between 20 and 11,000 cycles per second (must be phased and have gain adjusted at each modulation frequency at which phase shift is checked).

METHOD OF OPERATION

A. Auxiliary Equipment

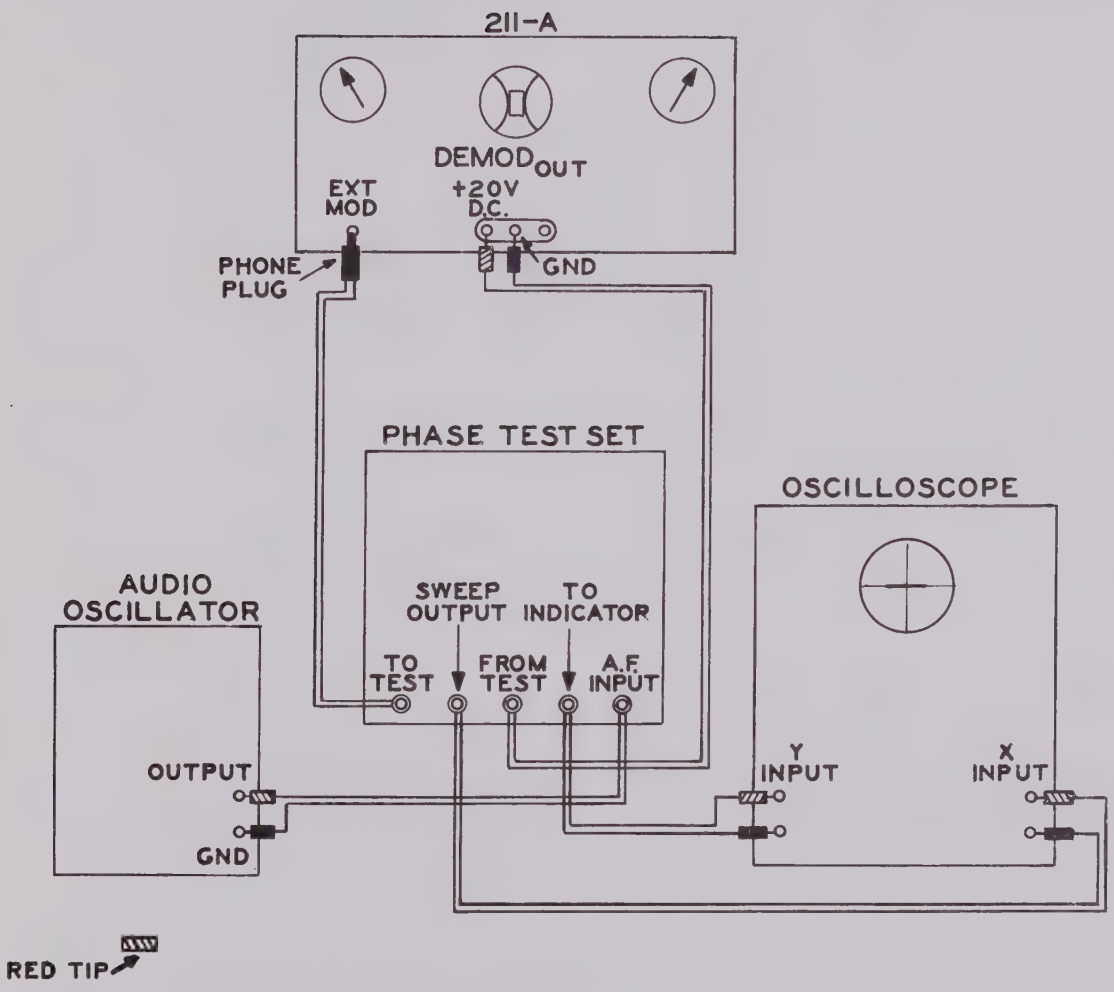
An audio oscillator and an oscilloscope are necessary for use with the PHASE TEST SET. The Hewlett-Packard 201B audio oscillator and the Dumont 304H oscilloscope have been found satisfactory for this use. However, any standard audio oscillator capable of delivering at least 20V of signal into a 1000 ohm load, and any standard oscilloscope with moderate amplifier gain may be used.

B. Adjustment of the 211A for zero Phase Shift at 30~

1. Interconnection of Equipment

a. Attach all cables to the PHASE TEST SET. The cable with detachable phone plug should be connected to the TO TEST jack.

CABLE FROM JACK ON PHASE TEST SET MARKED:	CONNECT TO:
To Test	EXT MOD jack of the 211A
Sweep Output	Horizontal ("X") amplifier input terminals of the oscilloscope
From Test	"+20V DC" demod posts of the 211A
To Indicator	Vertical ("Y") amplifier input terminals of the oscilloscope
AF Input	Output of the AF oscillator



INTER - CONNECTION DIAGRAM

Figure 3

2. Calibration

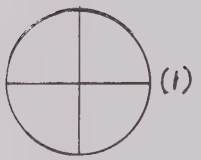
a. The audio oscillator, oscilloscope and 211A should be turned on and allowed a few minutes of warmup before calibration or testing.

b. Set the controls of the PHASE TEST SET as follows:

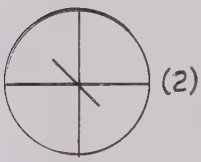
CONTROL	POSITION
CALIB-TEST	CALIB
30~ BRIDGE-DIRECT	30~ BRIDGE
BRIDGE CALIB	0°

c. Set the audio oscillator to 30 cycles, and adjust its output voltage to approximately 12V RMS.

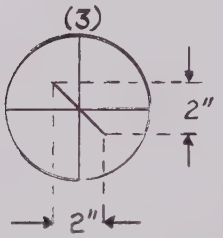
d. Switch the oscilloscope to use both the horizontal and vertical amplifiers.



e. Adjust the BRIDGE BALANCE control of the PTS for a horizontal line trace on the oscilloscope (1).



f. Set the BRIDGE CALIB switch of the PTS to the 1° position, and adjust the SWEEP PHASE control of the PTS for a line trace on the oscilloscope (2).

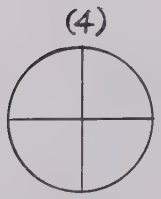


Also adjust the oscilloscope amplifier gain controls to produce a trace excursion that represents the diagonal of a square that is 2" on a side (on the Dumont 304H oscilloscope screen this is a 20 x 20 division square) (3).

The audio oscillator, PHASE TEST SET and Oscilloscope indicator have now been adjusted and calibrated so that they may be used to check or adjust the phase shift of a 30 cycle signal when passed thru the 211A, and at a modulation level of approximately 60%.

3. Adjusting the 211A for Zero Phase Shift

a. Turn the CALIB-TEST switch of the PTS to TEST, BRIDGE CALIB switch to 0°, and adjust the 211A for a "red line" reading on the "RF Monitor Meter".



b. Adjust the "Mod Level" control of the 211A to restore the oscilloscope trace to an approximately horizontal position. Use the MOD LEVEL control of the PTS for setting it exactly horizontal.

c. If no phase shift is present the trace will be a horizontal line (4). Phase shift results in an elliptical trace (5), and produces a vertical opening of the ellipse of 1 small division (1/10") for each 0.05° of shift - since the calibration procedure produced a reading of 2" for a 1° shift.

d. Adjustment of the 211-A for zero shift is now accomplished by alternately setting the phasing control of the 211A, P306, and then restoring the trace on the oscilloscope to horizontal using the "Mod Level" control of the 211A and the MOD LEVEL vernier control on the PTS. This is repeated until a horizontal line trace is obtained.

e. As a double check that the correct setting has been obtained, switch the CALIB-TEST Control of the PTS to CALIB. The resultant trace should be a horizontal line, proving that the PTS is still correctly calibrated.

NOTE: Phase shift in the 211A may be checked at any percentage of modulation between approximately 10 and 100% by resetting the output level of the audio oscillator and repeating the calibration procedure previously outlined.

C. Phase Shift Measurements between 20 and 11,000 Cycles per second (By conventional scope trace method)

1. Interconnection of equipment. This is identical to that previously described.

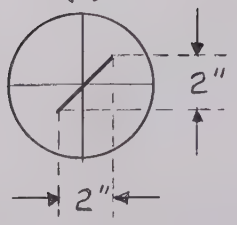
2. Calibration (must be repeated for each audio frequency at which it is desired to measure phase shift)

a. Set the controls of the PHASE TEST SET as Follows:

CONTROL	POSITION
CALIB-TEST	CALIB
30~ BRIDGE-DIRECT	DIRECT
BRIDGE CALIB	0°

b. Set the audio Oscillator to produce an output of 5V RMS at the frequency at which it is desired to measure the phase shift.

(6)



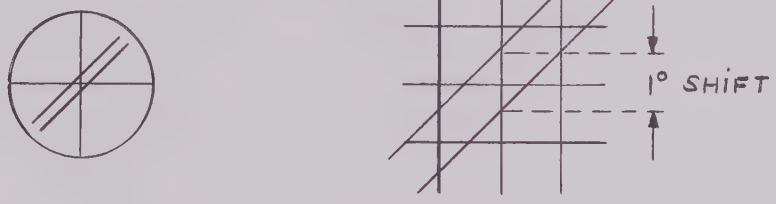
c. Adjust the SWEEP PHASE control of the PTS and the oscilloscope amplifier gain controls to produce a 45° hair line trace which represents the diagonal of a 2" square (20 x 20 division square on the Dumont 304H) (6).

d. Measure the RMS voltage at the input terminals of the oscilloscope vertical ("Y") amplifier, and increase it to 2.9 times its measured value by increasing the output of the audio oscillator.

e. Switch the CALIB-TEST switch of the PTS to its TEST position and adjust the "Mod Level" control of the 211A to restore a 45° trace on the oscilloscope (or alternately to provide the same RMS voltage at the vertical ("Y") amplifier input terminals of the oscilloscope as was produced in the preceding step (d).

3. Measurement

The phase shift may now be measured by observing the vertical distance between the two trace lines as they cross the vertical centerline, and is direct reading (1 small division or 0.1 inch = 1° when setup has been performed such that a 20 x 20 division trace was produced and then expanded 2.9 times (7).



(7) expanded view of center of oscilloscope screen with trace showing 1° shift.

Symbol	Description	Rating	BRC Number
C1	Capacitor, fixed mica	.003 uf	82321
C2,3	Capacitor, fixed mica	.01 uf	82416
F1	Filter, 30~lo-pass	Special	A302810
R1	Resistor, variable, wire wound	50 ohms	A81022
R2	Resistor, fixed, wire wound	470 ohms ±1% 1W	80194
R3,4	Resistor, fixed, wire wound	2.18 ohms ±1% 1W	80195
R5	Resistor, fixed, wire wound	100 ohms ±1% 1W	80196
R6	Resistor, variable, wire wound	15 ohms	A81023
R7	Resistor, fixed, wire wound	385 ohms ±1% 1W	80197
R8,9	Resistor, fixed, composition	470 ohms ±5% 1W	80124
R10	Resistor, fixed, composition	220,000 ohms ±5% 1/2W	80555
R11	Resistor, variable, composition	2.5 megohms	A81613
R12,13	Resistor, fixed, deposited carbon	100,000 ohms ±1%	80198
R14	Resistor, fixed, composition	200,000 ohms ±5% 1/2W	80536
T1	Transformer UTC LS-33		B302809
S1	Selector Switch DPTT		A88056
S2,3	Selector Switch DPDT		A88060
P-1,2,3,4,5	Plug Amphenol 75PC1M		302811

BRC-57-1K

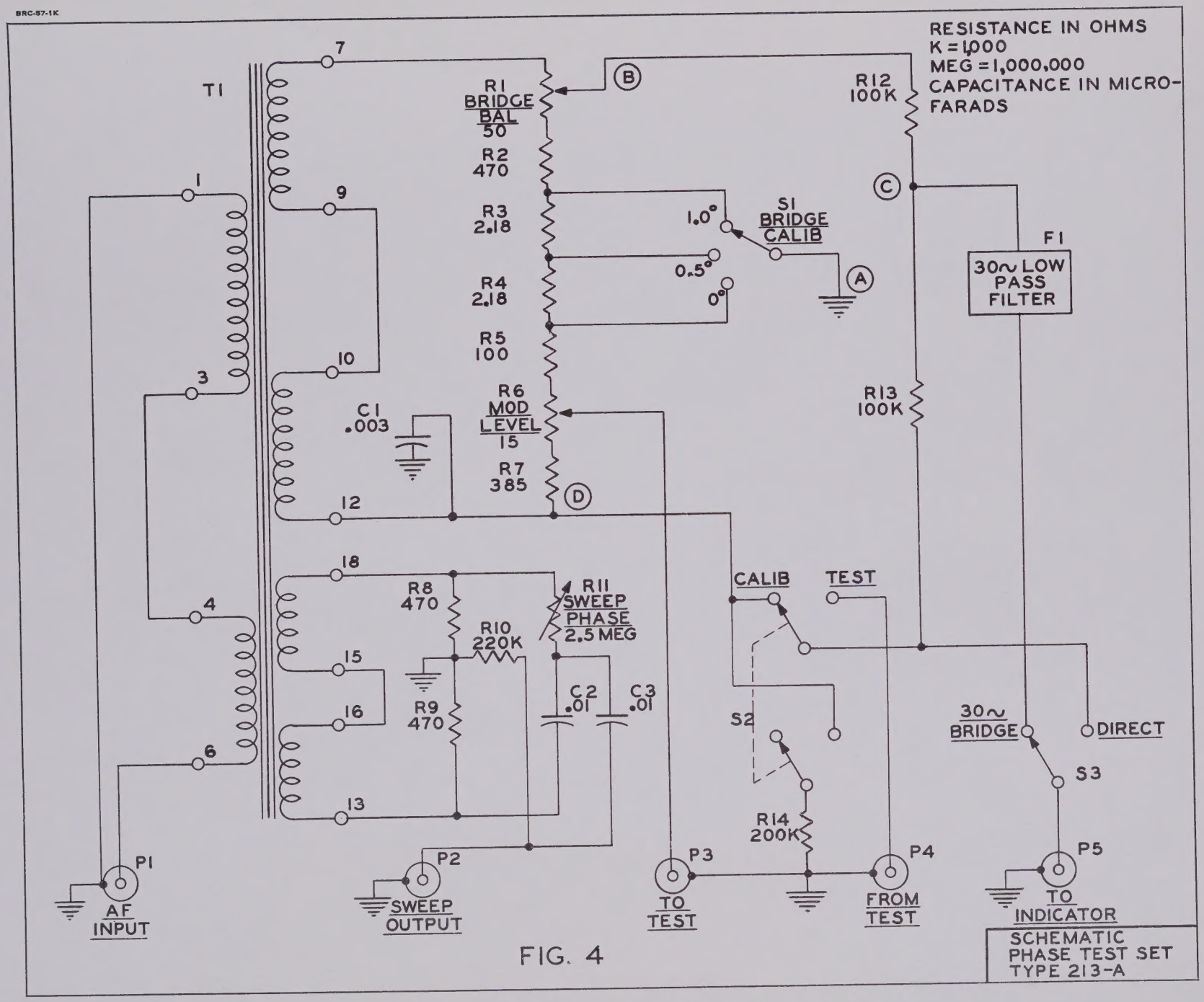


FIG. 4

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